

Safe and Effective Navy and Marine Corps Recruit Training Programs



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Promotion Conference

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**NHRC San
Diego**

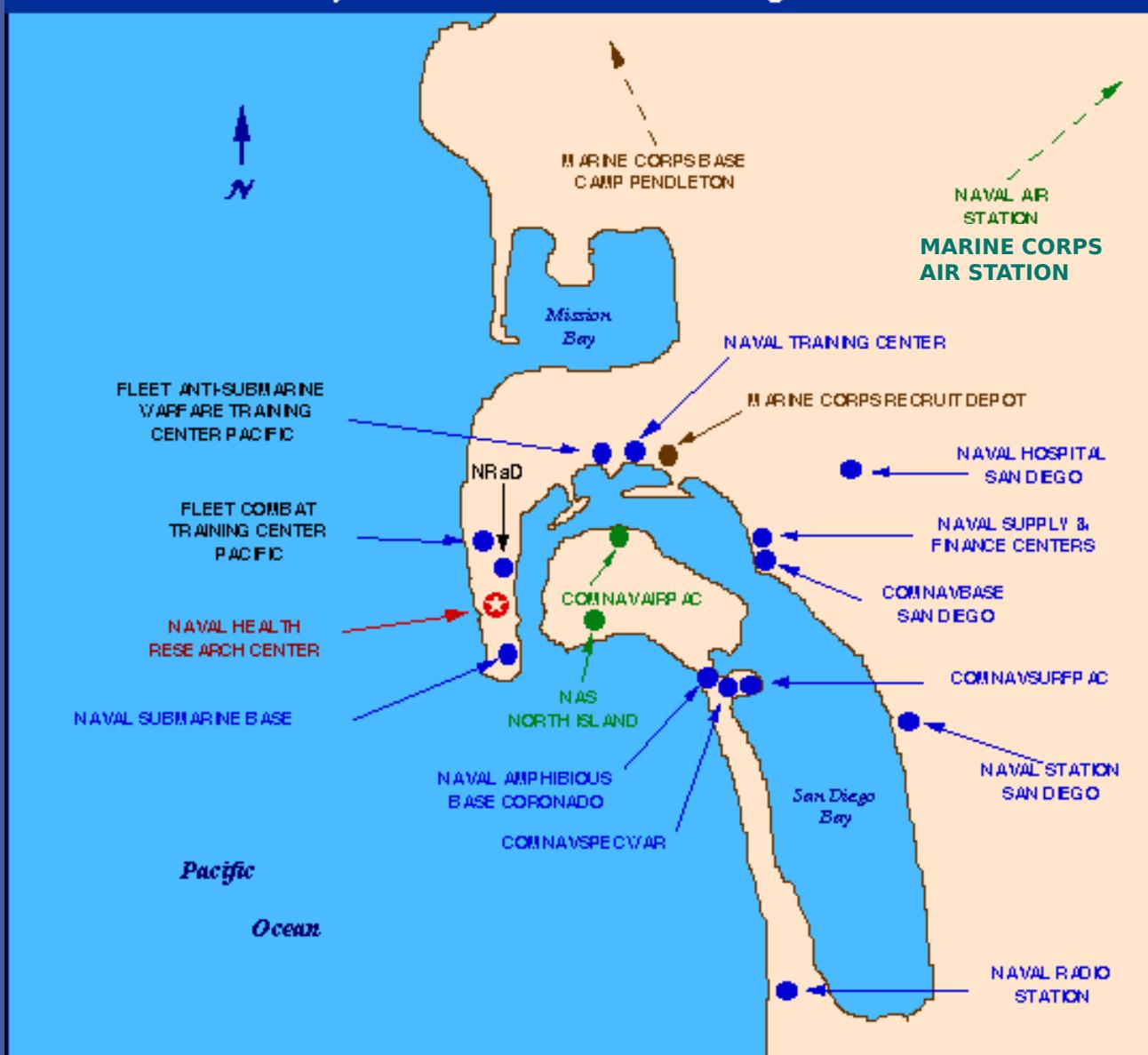


Presentation Outline

- Overview of the Naval Health Research Center, San Diego, CA
- Code 24 Operational Readiness Research Program
- Targets for injury prevention
- Classic study applied to operational setting
- Study design - observational
- U.S. Navy - women, men?
- Marine Corps - men, women
- Current Research Efforts (new starts)
- Published injury research



Major Naval Facilities in the San Diego Area



Naval Health Research Center

San Diego, CA



www.nhrc.navy.mil

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ONR / BUMED
Washington, D.C.

THE BIG PICTURE

Naval Health Research Center

Commanding Officer
Executive Officer
Administrative Officer
Command Chief

The laboratory's mission is to support fleet operational readiness through research, development, testing, and evaluation on the biomedical and psychological aspects of Navy and Marine Corps personnel health and performance.

Technical Director

Research Support:
Library
Computer Support
Financial Operating Services

Health Sciences &
Epidemiology

Medical Information
Systems & Operation
Research

Human Performance

Personnel as of Oct 2001

170 persons
25 military: 17 officers

8 enlisted

57 civil service: 29 GS2 to
GS11

28 GS12 to

GS15

88 contractors

- Health Sciences
- Clinical Epidemiology
- Occupational Epidemiology and HIV Studies
- Emerging Illness

- Medical Information Systems
- Operations Research
- Psychophysiology and Performance

- Heat Stress
- Cold Stress
- WBGT monitors
- Body Composition
- Biomechanics
- Special Warfare

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Sister Laboratories

- Naval Submarine Medical Research Laboratory
 - (NSMRL), Groton CT
- Naval Aerospace Medical Research Laboratory
 - (NAMRL), Pensacola, FL
- Naval Health Research Center (Toxicology),
Detachment
 - Dayton, OH
- Naval Health Research Center (Electromagnetic
Radiation) Detachment
 - San Antonio, TX



Operational Readiness Research Program

Head: CDR Richard Shaffer, Ph.D.,

MPH

- Determine illness and injury rates for samples or populations
- Identify important correlates (demographic, occupational, lifestyle, psychosocial)
- Develop and evaluate preventive strategies



**Reducing injuries in
training and
operational
populations**



**Improving lifestyle
behaviors and
reducing
preventable
diseases**

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Musculoskeletal Injury Projects

- Training Populations

- Determine rates of injuries
- Develop predictive profiles of injury susceptibility
- Develop and evaluate interventions to reduce injuries
- Surveillance



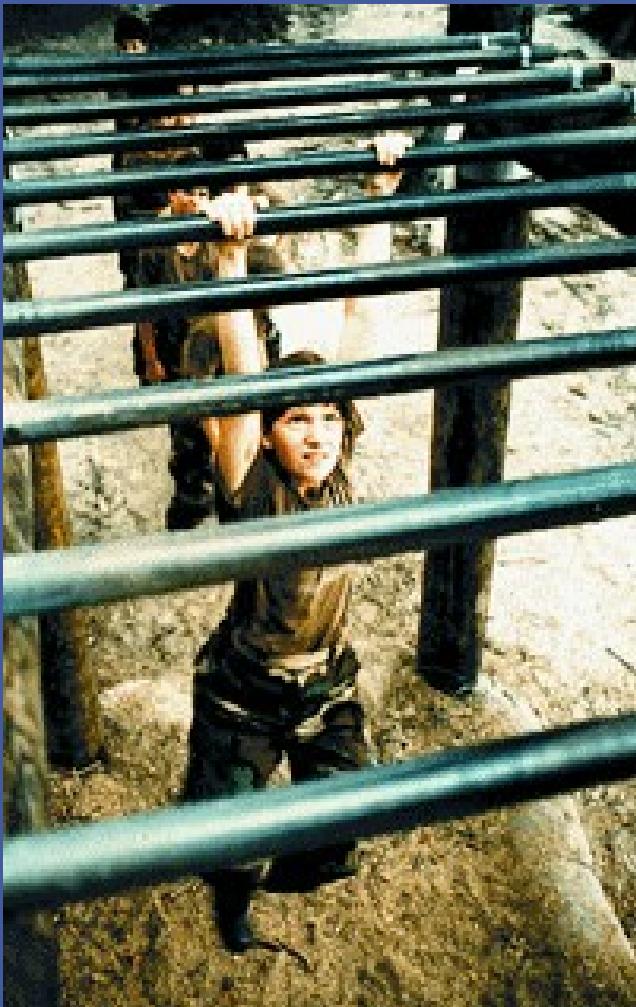


- Operational Populations

- Injury Study Subjects
 - Fleet Marine Force
 - Naval Aviators
- Study Objectives
 - Determine fitness and physical activity patterns related to MS injury
 - Determine risk factors for MS injury
 - Design preventive intervention



TRAINING



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Targets for Injury Prevention

- Recruit (Pre-Training fitness level)

→ Training Schedules

→ Exercise Techniques



Physical Fitness

Health related Fitness

Cardiorespiratory endurance

Body Composition

Musculoskeletal fitness

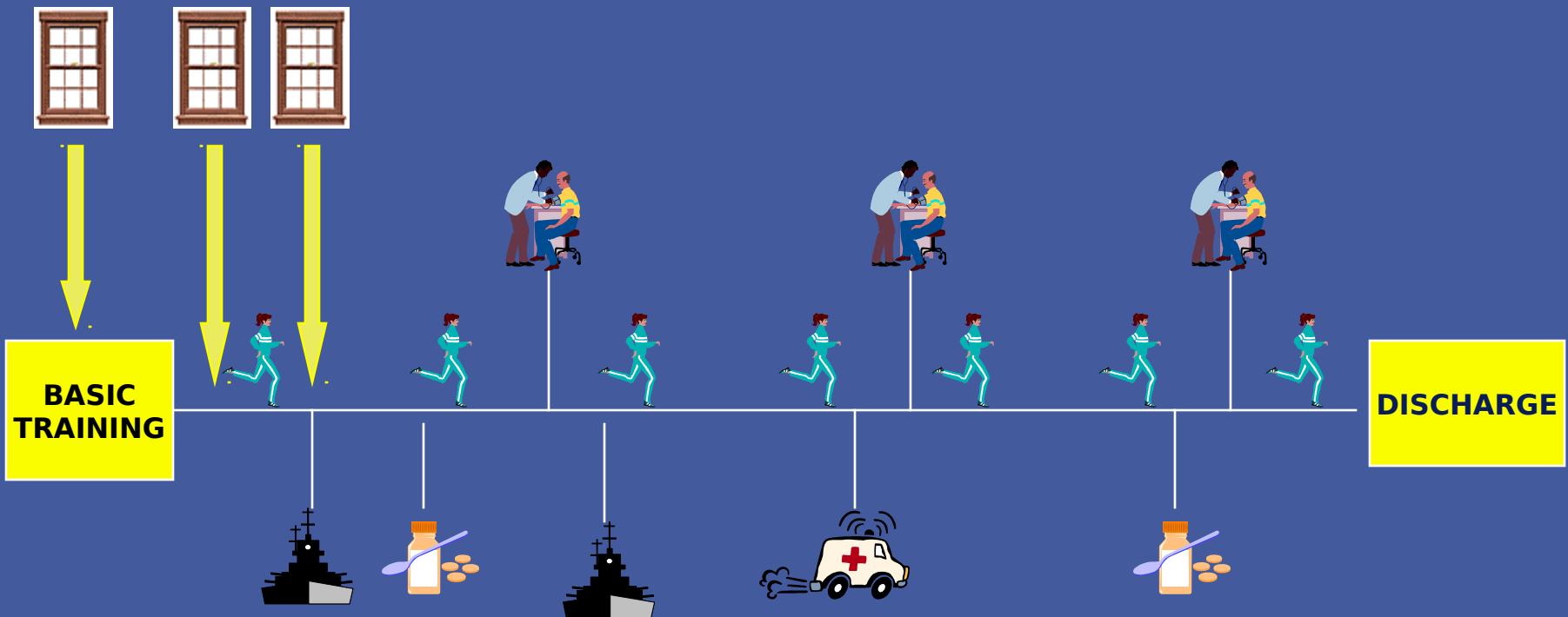
Strength
Endurance
Flexibility

Skill related Fitness

Agility,
speed,
power,
balance,
coordination
, reaction
time



The Accession Pathway and First-Term Enlistment





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Effects of Training Duration on Incidence of Injury and VO2 max*

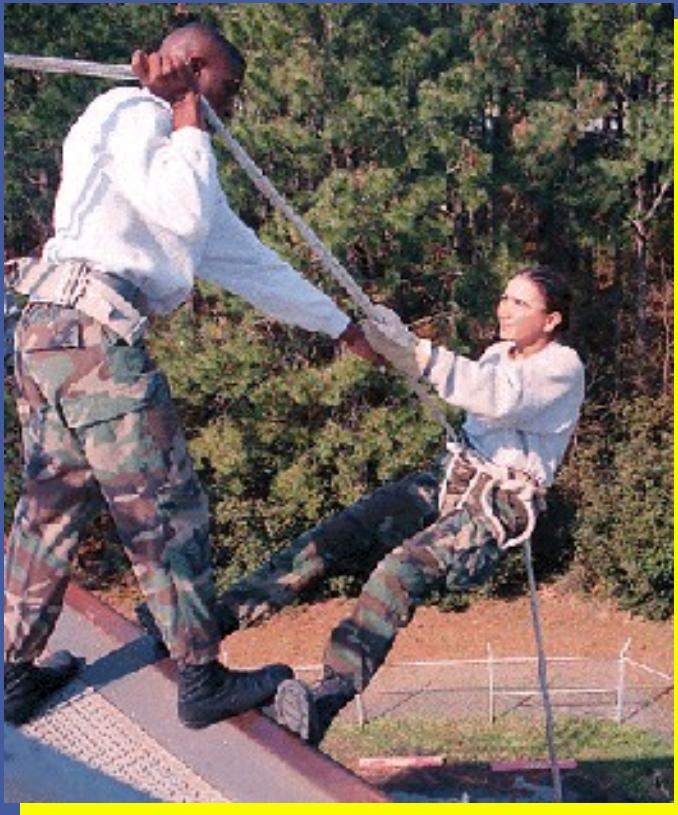
min/day	% injuries	%VO2 max (increase)
15	22%	8.6%
30	24%	16.1%
45	54%	16.9%

Training 3 days/wk, 85-90% HR Max

*Pollock, ML. Med Sci Sports. 9(1); pp31-36, 1977



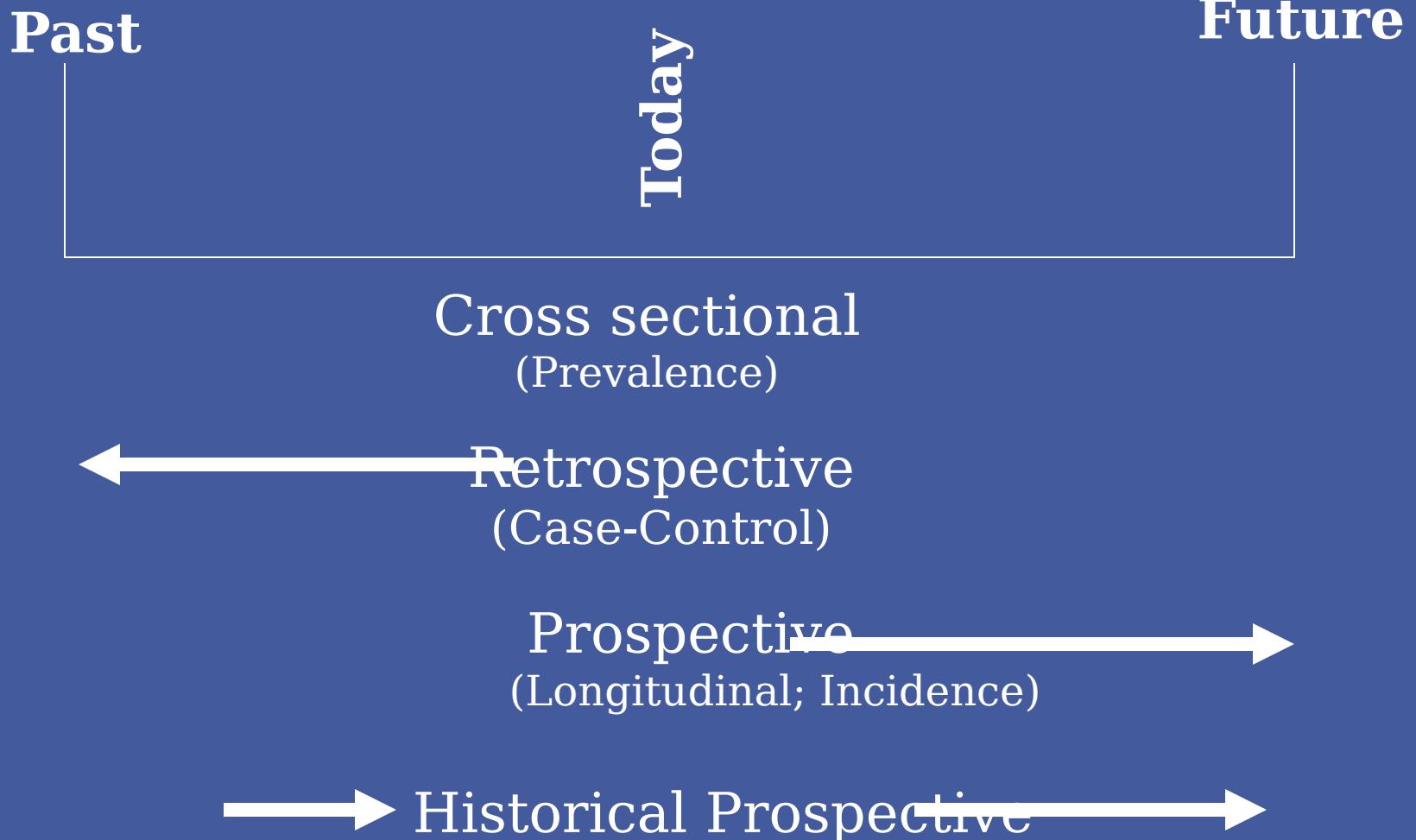
RESEARCH STUDY DESIGN





Observational Studies

(Study Design Taxonomy)





Goals of Study Design

- Eliminate/reduce bias
- Identify/control confounders
- Find associations
- Evaluate interventions



Potential Bias in Prospective Studies (systematic error)

- Outcome classification: Workable and concise criteria? Is the researcher blinded to exposure status? Are analysts blinded?
- Information bias: Are all independent variables collected the same for exposed and non-exposed? Is each subsequent exposure assessment consistent?



U.S. Navy Recruit Training Cen Great Lakes, IL

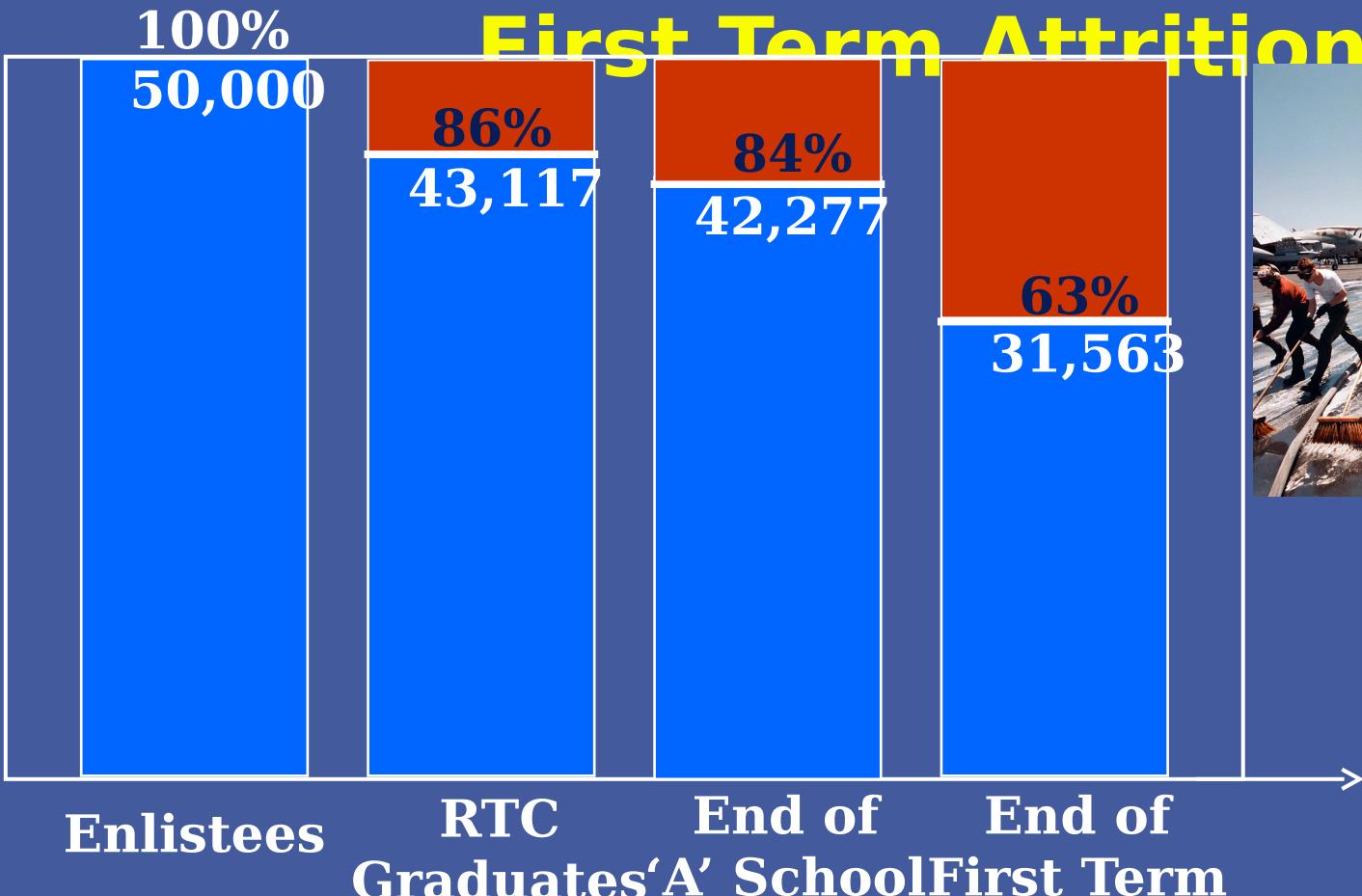


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U.S. Navy Injury Prevention

Why important?





Development and Assessment of Training Models for the Prevention of Musculoskeletal Injuries in Navy Recruit Populations

CDR Richard A. Shaffer (Ph.D., MPH)

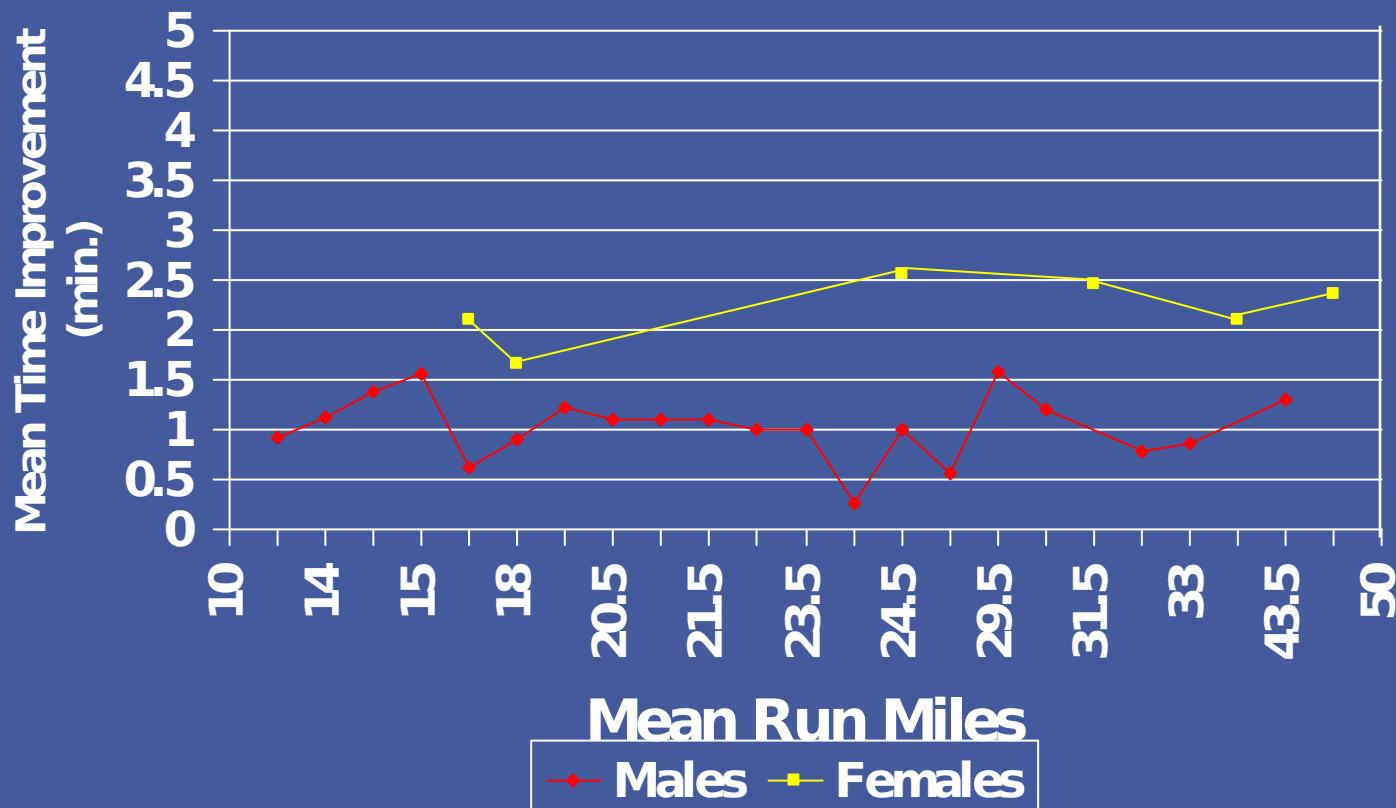
CAPT Stephanie K. Brodine (MD)(ret)

Rahn Y. Minagawa (Ph.D.); Stephen A. Tschinkel (MPH)

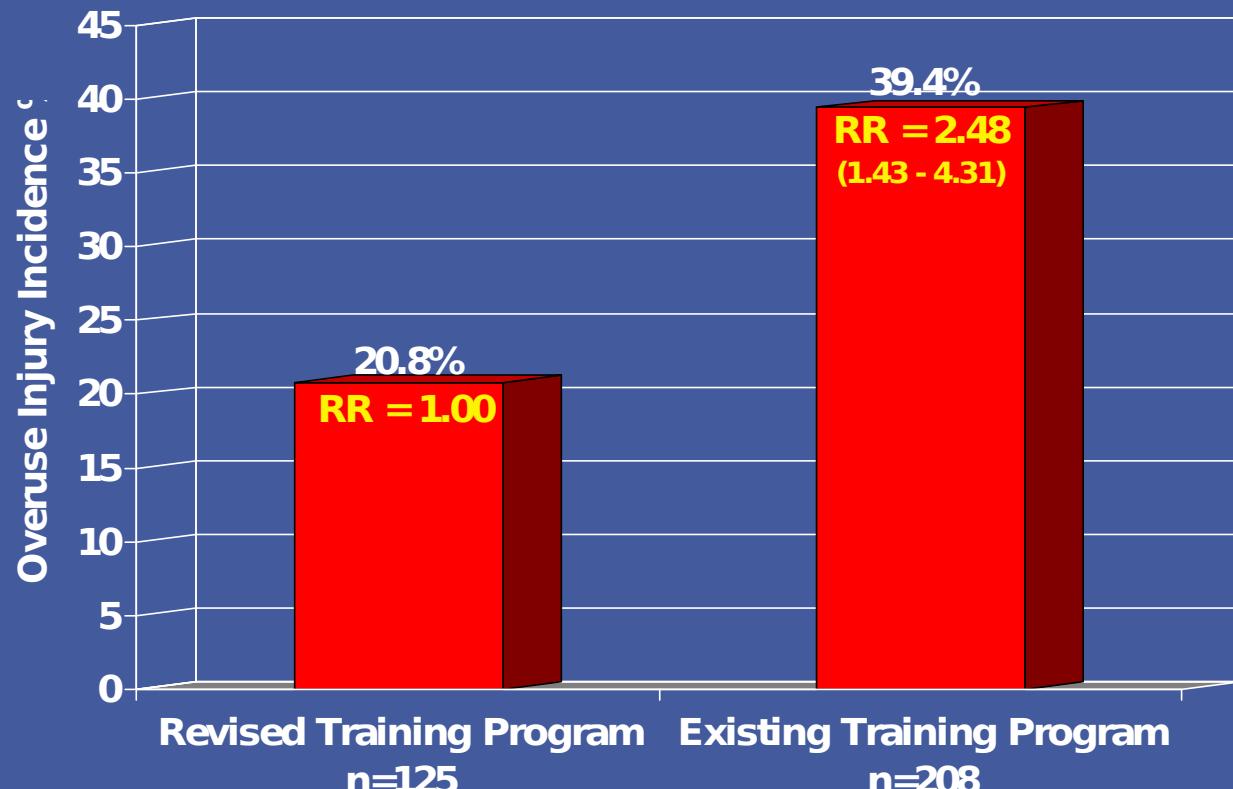
- Objectives / Goals :
 - Reduce MSI / STFX
 - Promote exercise and healthy habits long-term
- Methods :
 - Phase I - determine current MSI rates; objective and subjective
 - Phase II - quantify existing physical training (RDC logbooks); suggest revisions
 - Phase III - implementation using counterbalanced design
- Results : next two slides
- Conclusions



Run Time Improvement by Run Miles RTC Great Lakes

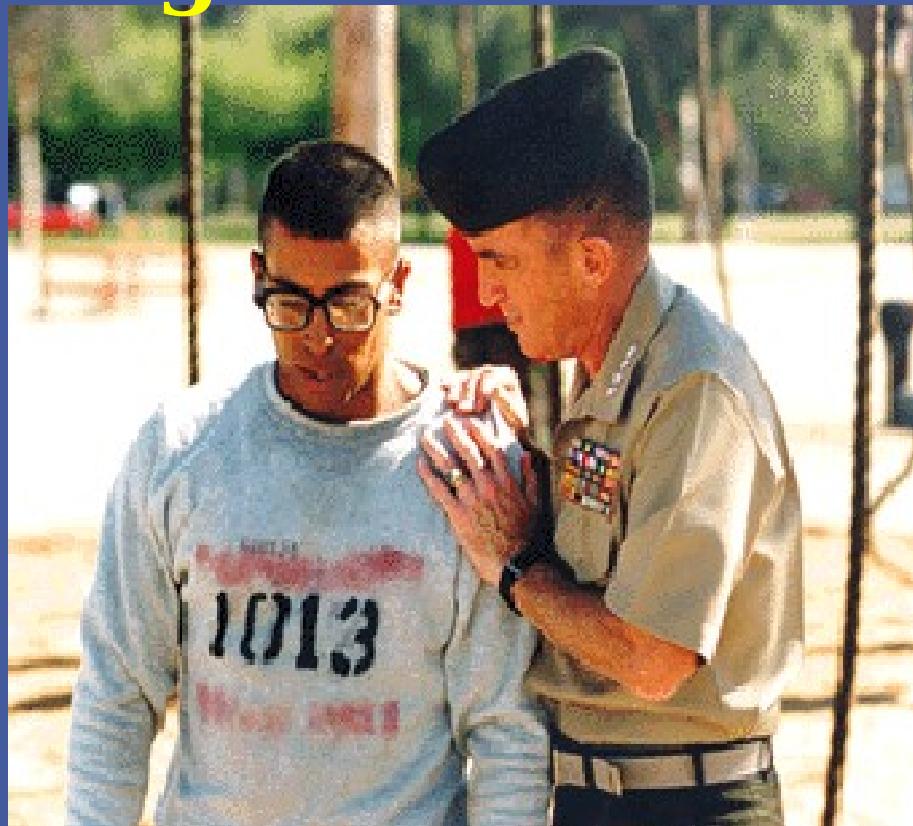


Overuse Injury Rates of Female Recruits Undergoing Revised versus Existing Physical Conditioning Protocol RTC Great Lakes





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Impact of Injuries MCRD San Diego

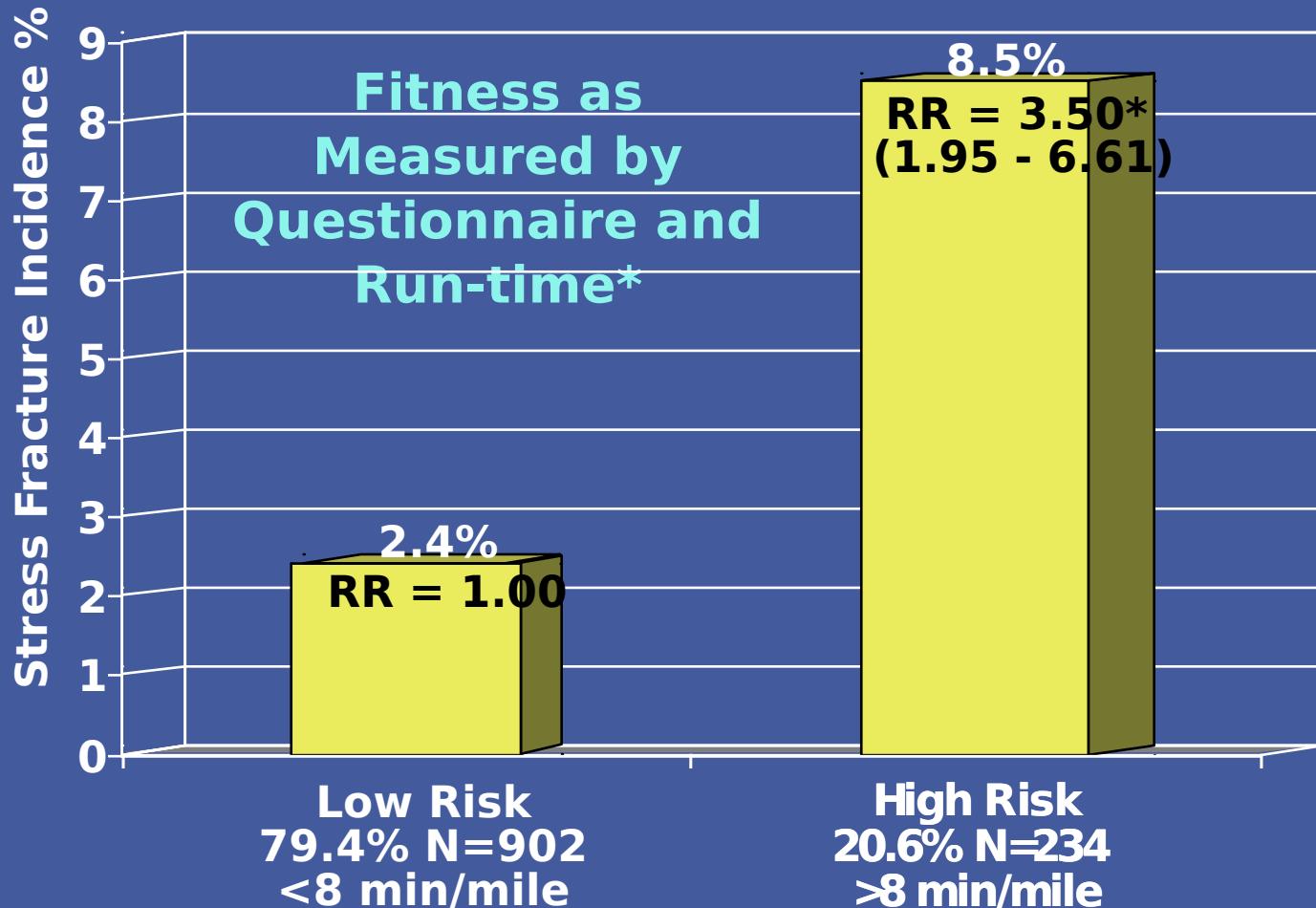


Fiscal
\$16.5 Million

Readiness
53,600 lost training days

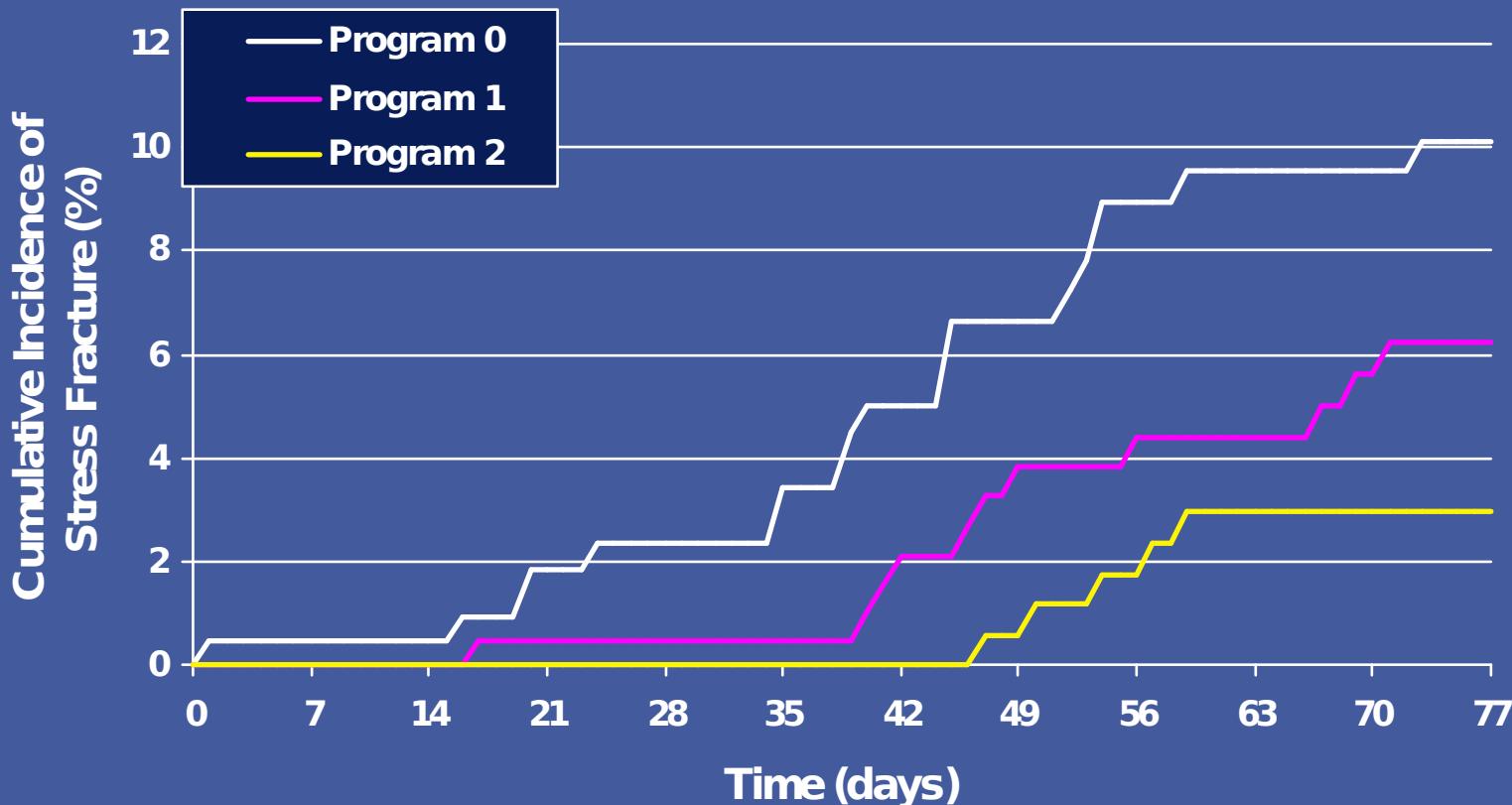


Results from Predictive Model for Stress Fracture Male USMC Recruits





Cumulative Incidence of Stress Fracture Among High Risk Recruits in Each Training Program During Recruit Training

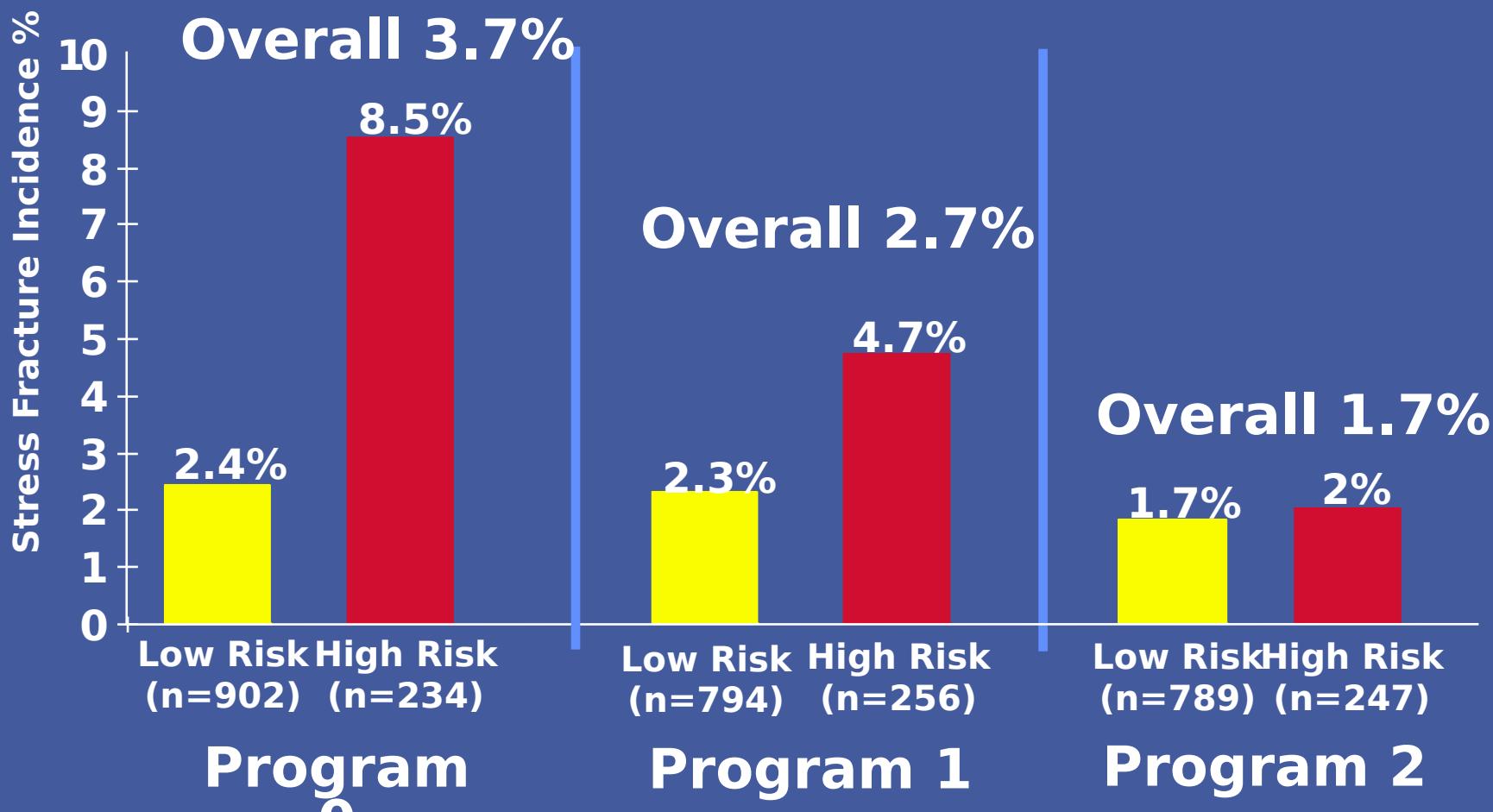


Initial Number of High Risk Recruits: Program 0 = 234; Program 1 = 256; Program 2 = 247

*Curves adjusted for the changing number of persons at risk over time.



Stress Fracture Incidence by Injury Susceptibility Groups



Shaffer, R.A. et al. Musculoskeletal Injury Project. In 43rd Annual Meeting of the American College of Sports Medicine. Cincinnati, OH, 1996. Invited speaker; **NHRC San Diego**
abstract not available.



Final PFT Results

Program 1 Program 2

Score (mean)	263.70	262.20
Run Time (mean)	20:44	20:53
Pull-Ups (mean)	18.97	18.89
Sit-Ups (mean)	79.32	80.99



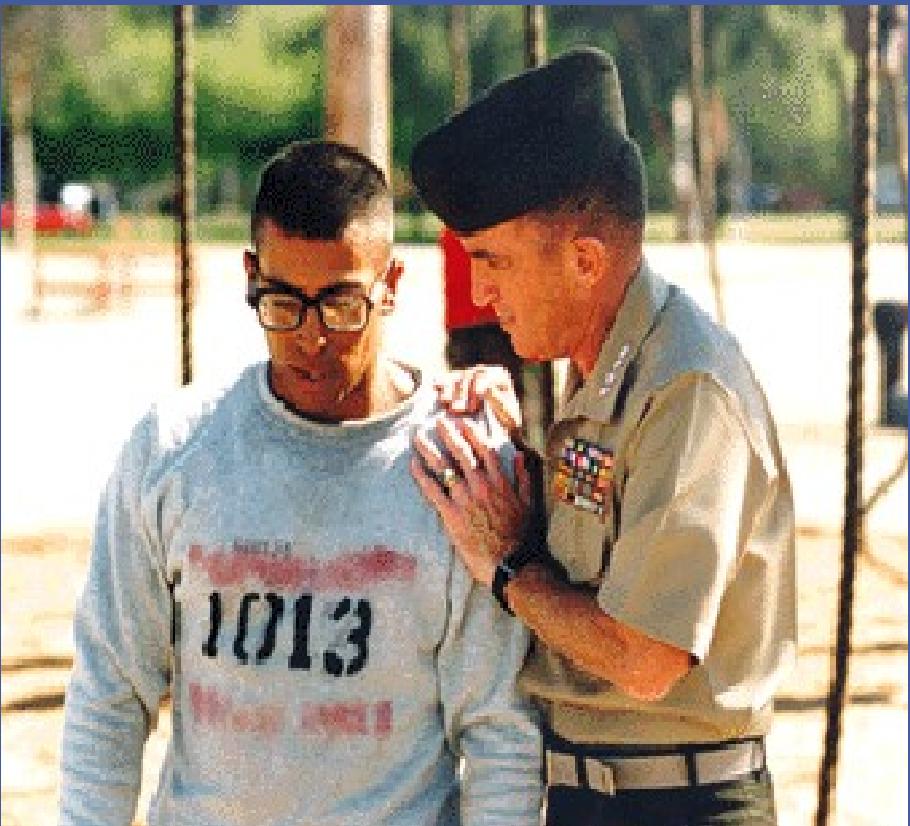
Morbidity and Cost Savings

A 50% reduction in **stress fractures**

- 370 less stress fractures per year
- Prevent 14,800 lost training days
- Cost savings of \$4.5 million per year



MCRD- Parris Island



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Evaluation of a Modified Physical Conditioning Program for Female Marine Corps Recruit Training



Daniel W. Trone, M.A., Timothy L. Bockelman, KT, CSCS#, Scott Flinn*, CDR, MC, USN, Kelli A. Betsinger*, B.A., Heidi Kraft, LT, MSC, USNR, David H. Ryman, B.S., & Richard A. Shaffer, CDR, MSC, USN



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Physical Fitness Advisor, Support Battalion Headquarters Company, MCRD-PI, SC

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Physical Fitness Test Run Times

Group	Run Time Mean (SD), Range
p-value	
IST 1.5-mi Run	
All Recruits n = 813	
• 1 Old POI	13:05 (1:22), 9:10 - 16:20
p=0.02	1 vs. 2
• 2 Revised POI	13:29 (1:17), 9:54 - 16:40

PFT 3.0-mi Run

All Recruits n = 822
• 1 Old POI 27:50 (2:45), 19:20 - 33:08 1 vs. 2 p=0.001
• 2 Revised POI 26:43 (2:30), 20:00 - 32:14



Relative Risk

Injury category	Old POI vs. Revised POI	Relative Risk (p=value)	(95% CI)
• All Injuries	0.03	1.26 (1.01,1.56)	
• Acute	0.26	1.24 (0.85,1.82)	
• Overuse	0.09	1.27 (0.96,1.68)	
• Stress fracture	0.08	2.22 (0.88,5.60)	
• Pelvic/Femoral Stress fracture		0.52	1.59 (0.39,6.50)
• Hip sprain/strain	0.12	2.38 (0.77,7.40)	
• Tend/Burs Knee/Lower Leg		0.08	1.82 (0.92,3.61)



Graduation Rate by POI

Series	Grad on schedule	Grad	Separated
Old POI	78.1%	85.2%	14.8%
Revised POI	78.7%	91.8%	8.2%
Total	78.4%	88.4%	11.6%



Cost Analyses - Crude

- Does not include:

- medical separation pay
- facilities fees
- direct nor indirect personnel costs

- Does include:

- 1999 salary and chow cost

E-1 < 4 mo. \$909.00/mo.
\$30.30/day

E-1 > 4 mo. \$982.50/mo.
\$32.75/day

E-2 Graduates \$1,101.60/mo.
\$36.72/day



Other Cost Metrics

Series	Total PI Days	Recruit Salary and Chow
Old POI	12,145	\$471,040
	111 per Grad	\$4,321 per Grad
Revised POI	11,471	\$443,854
	102 per Grad	\$3,963 per Grad
Total	23,616	\$914,894
	107 per Grad	\$4,140 per Grad

“Savings” - women only

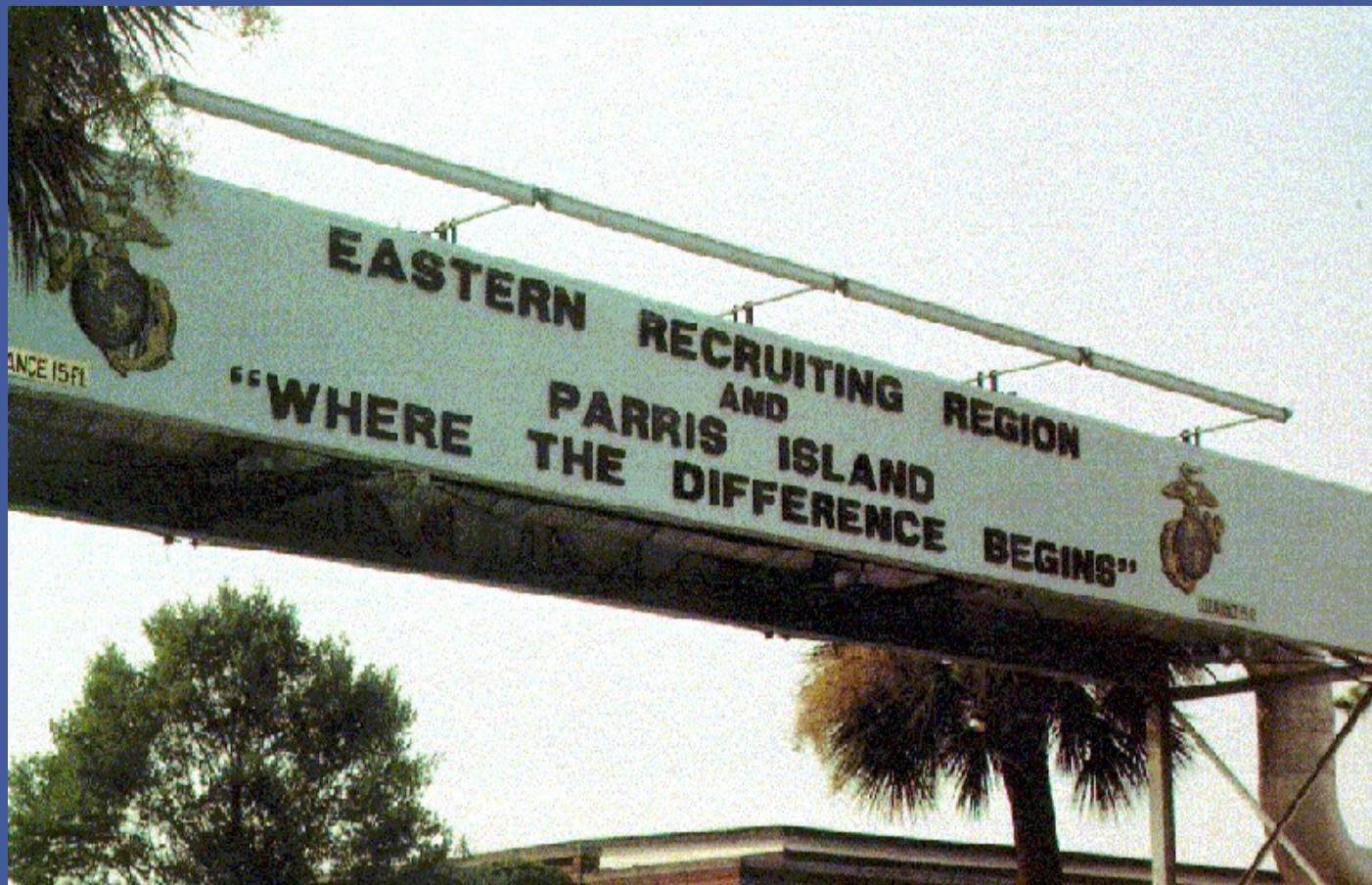
\$358 per Grad **~\$789,000 per year**

9 PI days per Grad **~19,800 training days per year**



Conclusions

The physical training recommendations to the female Marine Corps recruits' program of instruction, made by the 4th Battalion Commanding Officer and the Support Battalion Physical Fitness Advisor, significantly reduced the number of stress fractures and the overall injury rate while maintaining high-intensity physical activity.



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Current Research Efforts (New Start)



First-Term Outcomes Associated with Lower Extremity Injury in Female Marine Corps Recruits: A Historical Prospective Study

- **Bone BAA: Army Reimbursable; USAMRMC (Oct 2001 to Sept 2003)**
- **Background: MCRD-San Diego (men) STFX and graduated. First-term outcomes.**
 - N = 1,131 STFX n = 56 of which 39 graduated
 - 2.14 times discharge any reason
 - 6.12 times discharge physical disability
- **Proposed: MCRD-Parris Island (women)**
 - N = 2,962 STFX n = 152 of which 97 graduated
 - Causal relationship not assumed
 - May suggest STFX or severe MSI are associated with first-term discharge

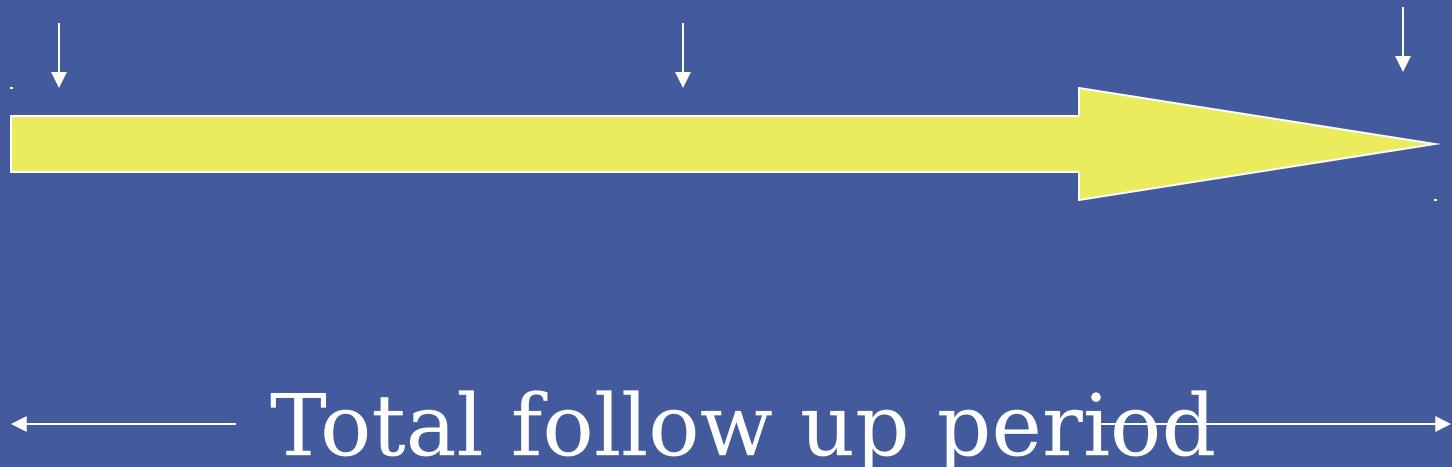


Historical Prospective Study (Non-concurrent Cohort Study)

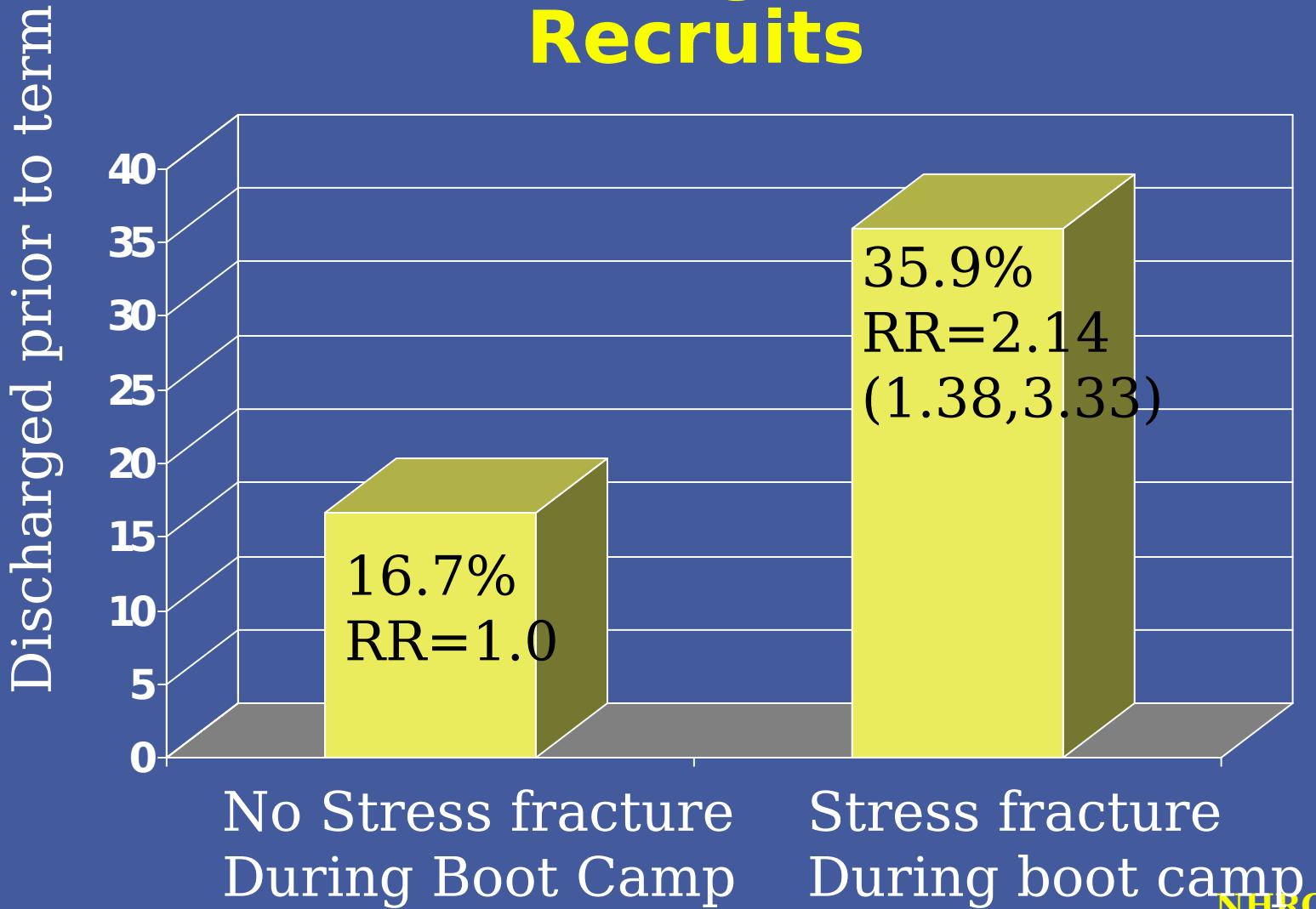
Establish
exposure

Begin study
(now)

End of follow
up per

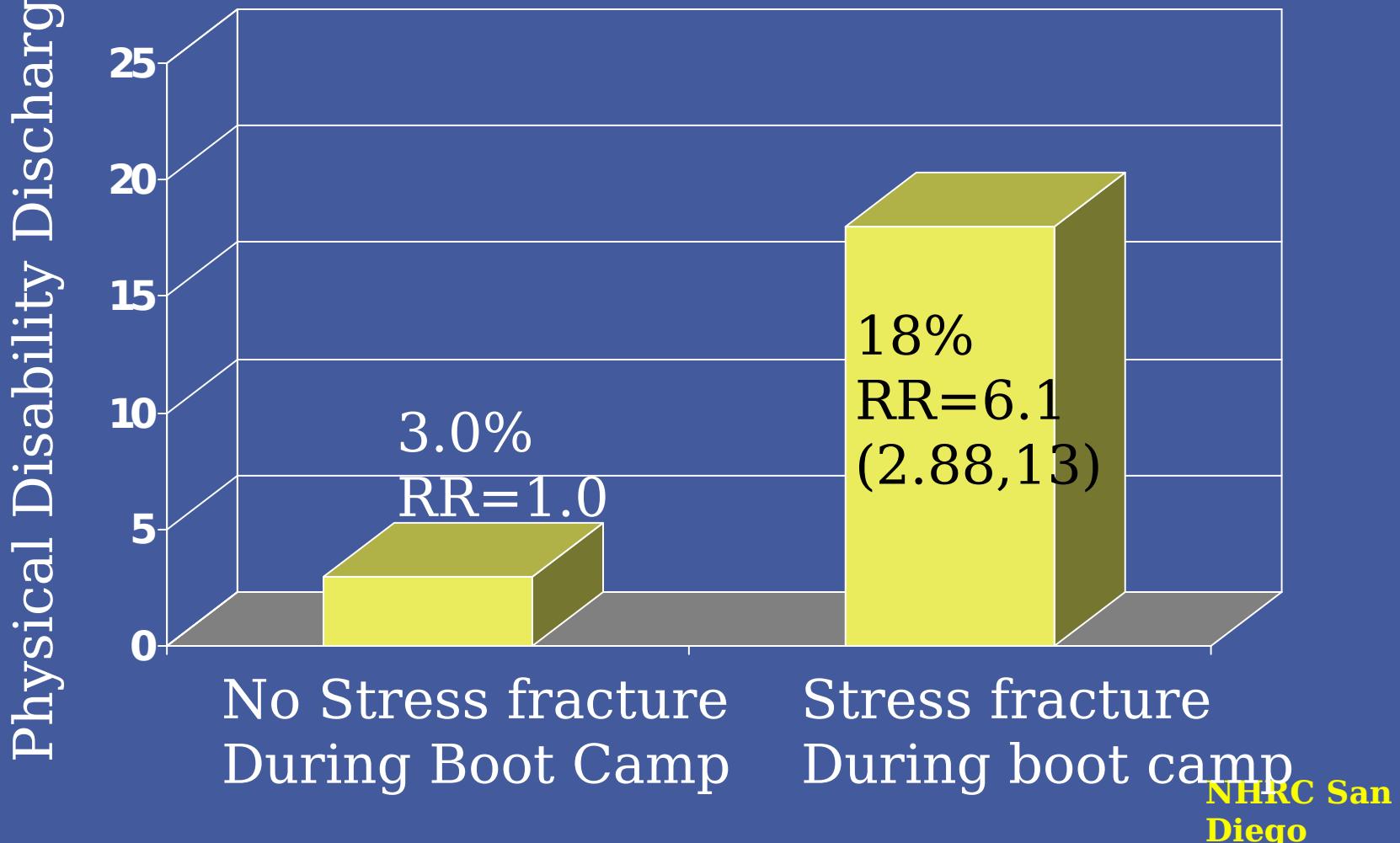


Long term Outcomes Associated with Injury during Recruit Training, USMC Male Recruits





Long term Outcomes Associated with Injury during Recruit Training, USMC Male Recruits





STATEMENT OF WORK

- **First Year:**

- **Peruse CHAMPS (The Career History Archival Medical and Personnel System)**
- **Determine first-term enlistment disposition**
- **Additionally, three measures of success will be examined:**
 - **completion of the first-term enlistment**
 - **completion of the first-term enlistment rank of Lance Corporal or Corporal**
 - **retention beyond the first-term enlistment**
- **Discharged: any reason or due to physical disability**

- **Second Year:**

- **Evaluation for hospitalizations and attrition**
- **Divide into MSI and STFX groups**
- **Report: estimated financial, manpower, and Fleet readiness impact**

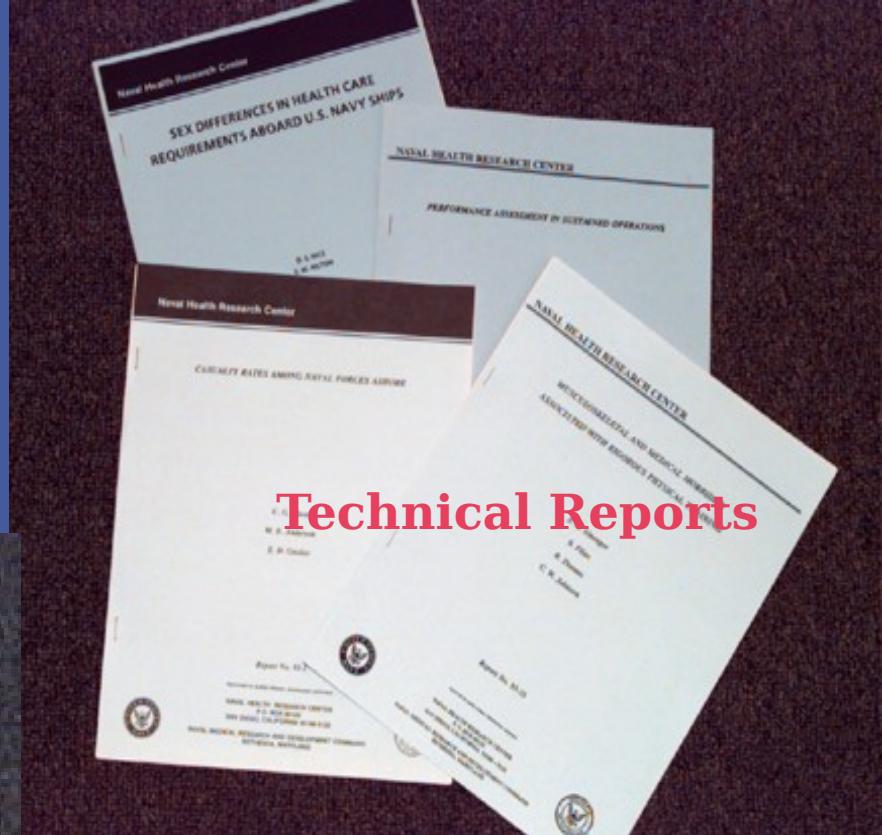


Current Research Efforts (New Starts)

- **Basic Underwater Demolition / SEAL trainees (BUD/S)**
- **MCRD - San Diego**
- **MCRD - Parris Island**



Published Research



Technical Reports



NHRC Operational Readiness Research Program



Published Injury Research

Running mileage, movement mileage, and fitness in male U.S. Navy recruits. *Med Sci Sports Exerc* 2001; 33:1033-1038.

Stress fracture in military recruits: gender differences in muscle and bone susceptibility factors. *Bone* 2000; 27:437-444

Military Training Related Injuries: Surveillance, Research, and Prevention. *Am J Prev Med* 2000; 18:54-63.

The association of blisters with musculoskeletal injuries in male Marine recruits. *J Am Podiatr Med Assoc* 2000; 90:194-198.

Gender differences in musculoskeletal injury rates: a function of symptom reporting? *Med Sci Sports Exerc* 1999; 31:1807-1812.

The effect of foot structure and range of motion on musculoskeletal overuse injuries. *Am J Sports Med* 1999; 27:585-592.

Use of simple measures of physical activity to predict stress fractures in young men undergoing a rigorous physical training program. *Am J Epidemiology* 1999; 149:236-242.

Epidemiological pattern of musculoskeletal injuries and physical training. *Med Sci Sports Exerc* 1999; 31:1176-1182.

Physical training program guidelines for U.S. Navy recruits: Preparing recruits for Battle Stations. NHRC TR No. 99-1A.

A physical training program to reduce musculoskeletal injuries in U.S. Marine Corps recruits. NHRC TR No. 97-2B 1997.

Biomechanical properties of infantry combat boot development. NHRC TR No. 97-26 1997.

Dual Energy X-Ray Absorptiometry Derived Structural Geometry for Stress Fracture Prediction in Male U.S. Marine Corps Recruits. NHRC San Diego.



Risk Factor Algorithm: Stress Fracture

STAGE

Algorithm for the assignment of subjects to a high or low risk group for stress fracture based on a self-report questionnaire and a 1.5-mi (2.4 km) run. U.S. Marine Corps recruit training, San Diego, California.

-AJE, vol. 149 (3), Shaffer et al.

STAGE

3

PHYSICAL FITNESS INDICATOR

time

1.5 Mile run

Slower or equal to
12:00 mins

At least
one

Faster than 12:00
mins

High
Risk

HIGH PHYSICAL ACTIVITY INDICATORS

- a. Sweat: Quite a lot/all the time during activity
OR
- b. Very good/excellent self-reported fitness
OR
- c. Have been running longer than the 3 previous months
OR
- d. Have ever been injured and fully recovered

STAGE

2

LOW PHYSICAL ACTIVITY INDICATORS

- a. Sweat: Only occasionally OR
- b. Poor or fair self-reported fitness OR
- c. Weekly exercise frequency $\leq 2x$

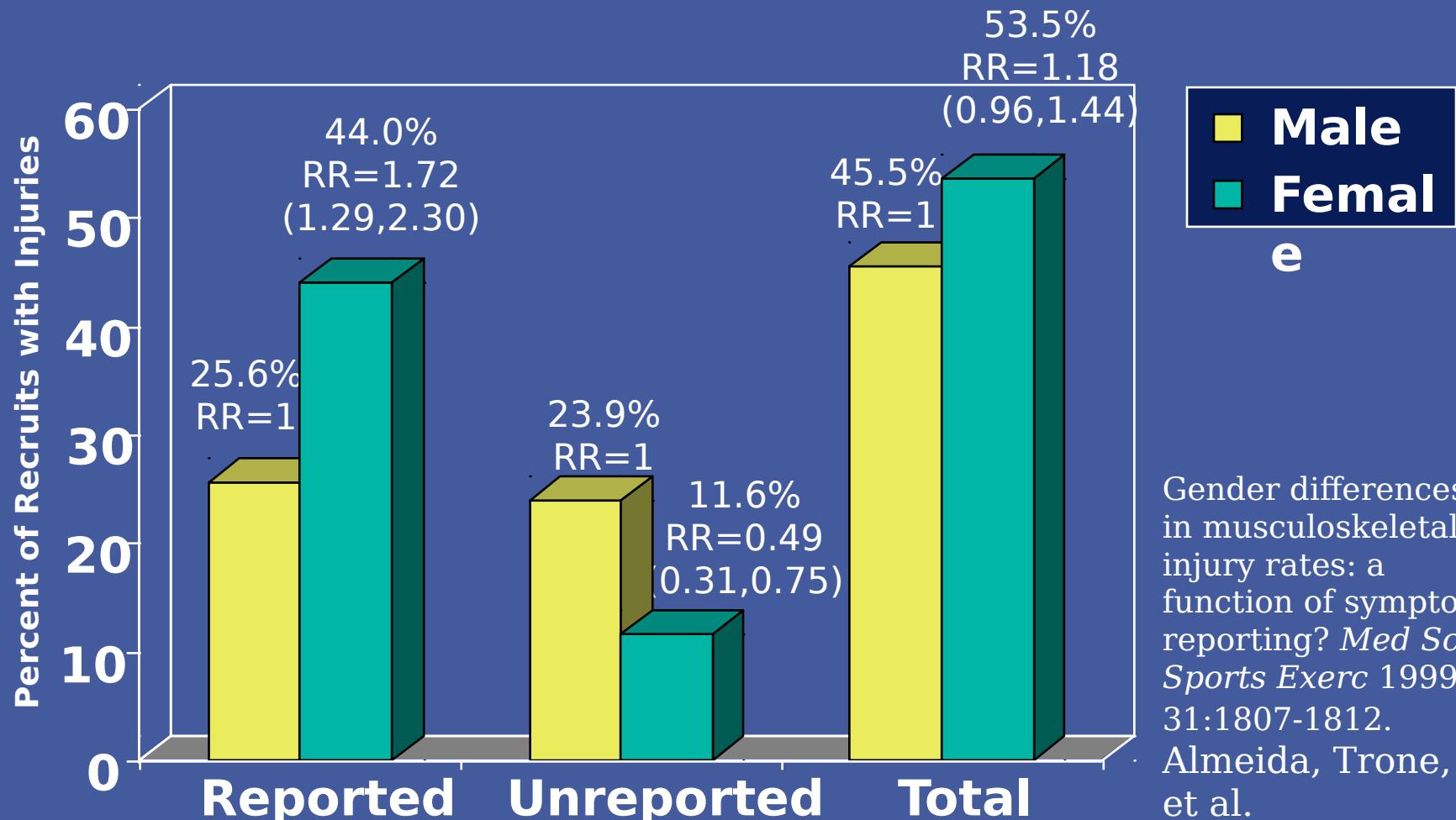
None of the above

Low
Risk

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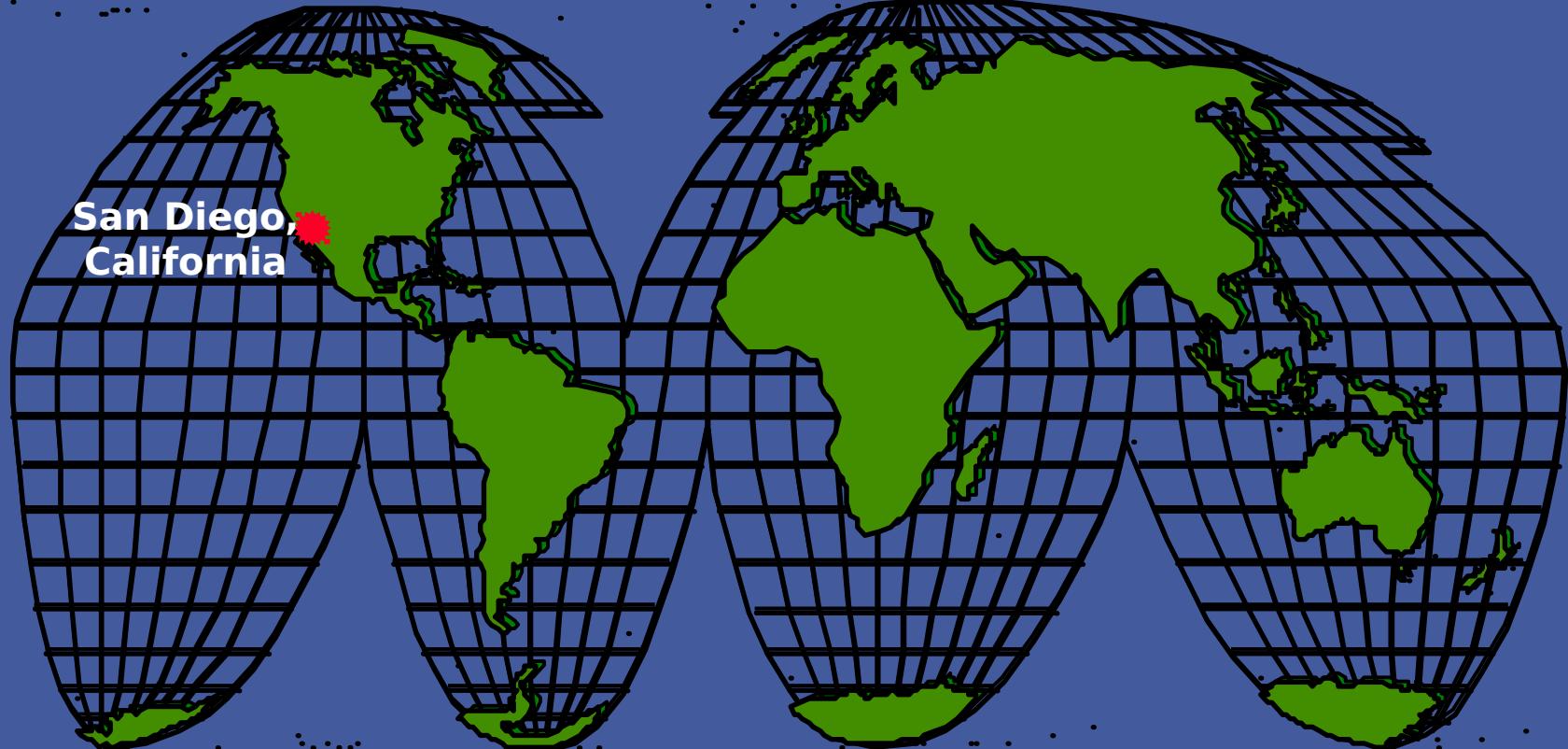


Gender Differences in Injury Rates U.S. Marine Corps Recruits





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